

Results from Water Quality Monitoring Conducted during Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar Rivers

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Abstract: From August 2-9, 2008, 221 volunteers participated in Project AWARE 2008 (A Watershed Awareness River Expedition), a weeklong river cleanup on the Winnebago, Shell Rock, and Cedar rivers in north-central Iowa. Project AWARE is a 7-day, 7-night float trip down an Iowa river that allows volunteers to participate in a river cleanup, water quality monitoring, and evening educational programs. A record 47.4 tons of trash were removed from the 80.4 miles of the Winnebago, Shell Rock, and Cedar rivers through Cerro Gordo, Floyd, Butler, Bremer, and Black Hawk counties. A total of 65% of the trash was recycled. Project AWARE is an initiative of the Iowa Department of Natural Resources IOWATER, Water Trails, and Keepers of the Land programs, and 2008 represented the sixth year of the event. The event was made possible through the financial and in-kind support of 141 sponsors.

In addition to trash removal, 36 stream sites along the canoe route were monitored for a variety of water quality parameters using a combination of IOWATER methods and field meters. Monitoring occurred during slightly above normal to normal stream flow conditions. These more normal flow conditions occurred after the Winnebago, Shell Rock, and Cedar rivers reached unprecedented levels associated with the historic flooding in mid June 2008. For most of the parameters, concentrations at these sites during Project AWARE were similar to those measured in streams statewide for August 2008. Results from the Project AWARE sites showed that water temperature and turbidity were lower for the Project AWARE sites than for streams statewide; pH, specific conductivity, and chloride were similar to statewide values; and dissolved oxygen was slightly higher for Project AWARE sites. Dissolved oxygen results for all but one Project AWARE site were greater than the 5 mg/L water quality standard.

This report summarizes the water quality results for sites monitored during Project AWARE 2008. For more information on Project AWARE, go to www.iowaprojectaware.com.

Introduction

Project AWARE, which stands for A Watershed Awareness River Expedition, is the Iowa DNR's weeklong volunteer river cleanup event during which hundreds of Iowans spend anywhere from a day to an entire week improving Iowa's waterways by removing trash. In addition to trash removal, participants on Project AWARE learn about water quality, wildlife conservation, recycling, and other topics related to Iowa's natural resources. Project AWARE 2008 represents the 6th year of this annual event, with the previous five years of Project AWARE paddling and cleaning up the Maquoketa River in northeast Iowa, Des Moines River in north-central, Little Sioux River in northwest, Iowa and English rivers in southeast Iowa, and the Middle and North Raccoon rivers in west-central Iowa.

On Day 1 of Project AWARE 2008, participants paddled 16.5 miles on the Winnebago River, beginning at Asbury Park on the east side of Mason City in Cerro Gordo County and continued south to Rockford (Figure 1). From Rockford, participants paddled downstream to where the Winnebago River joins the Shell Rock River just south of Rockford. The event continued on the Shell Rock River through Marble Rock, Greene, Clarksville, and Shell Rock before joining the Cedar River just south of Janesville, and finished on the Cedar River at Island Park in Cedar Falls.

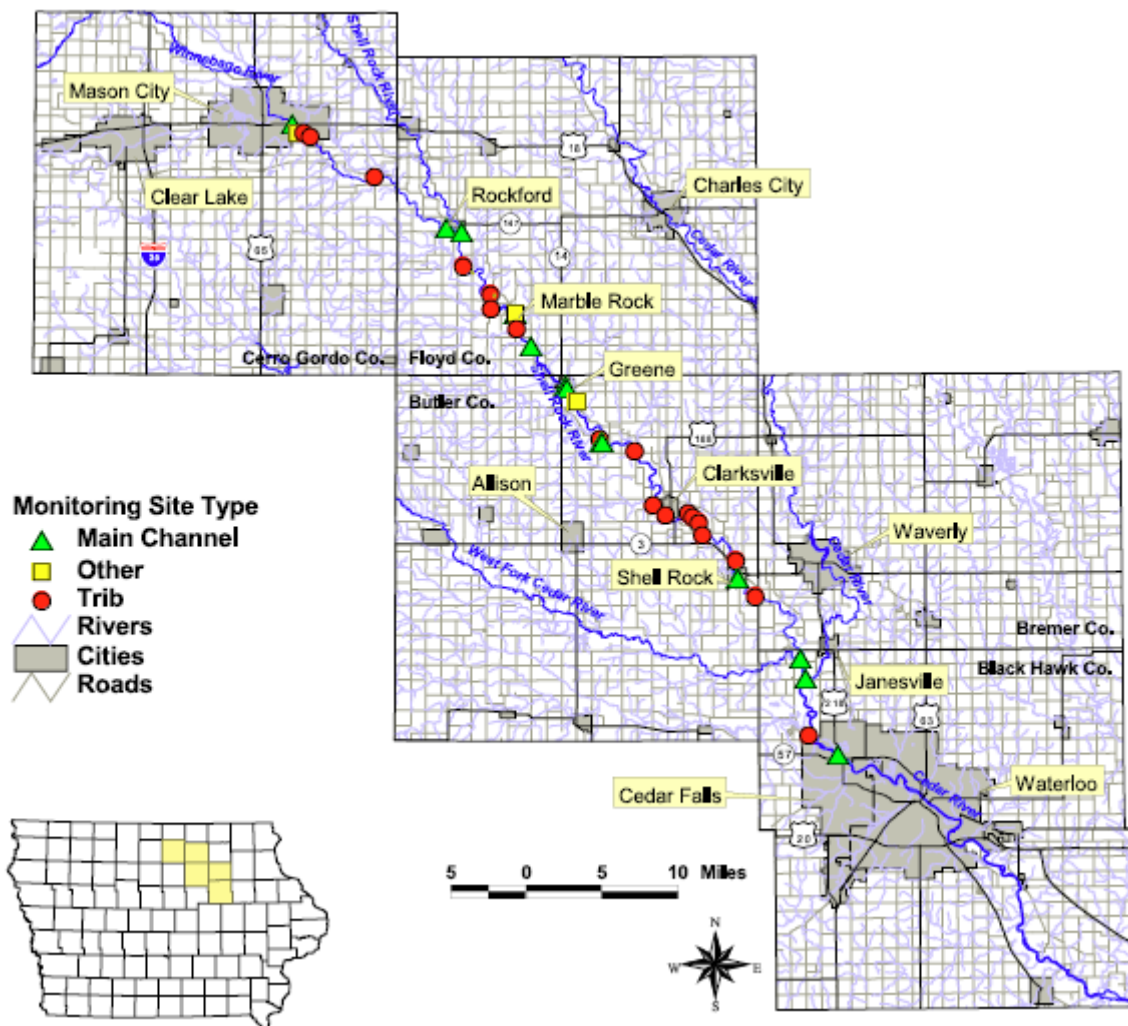


Figure 1. Location of sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

For each day of Project AWARE, a minimum of two people were identified to do water testing. At least one of the two people was IOWATER trained. Before beginning monitoring for the day, those individuals were trained in the

sample procedures, proper use of the field meters, and use of the hand-held GPS unit. Prior to the event, the author identified potential monitoring sites. Sites were selected based on starting, half-way, and take-out points for each day of Project AWARE; location of major tributaries entering the Winnebago, Shell Rock, and Cedar rivers; and other locations of interest (e.g., sites near known point sources or proximity to National Pollutant Discharge Elimination System permitted facilities or locations near unsewered communities). A total of 36 sites were sampled (Figure 1), including 15 on the main channel, 18 tributaries, and 3 other sites, two of which represented outfalls from municipal wastewater treatment facilities (Mason City, Greene). The City of Mason City has an activated sludge facility while the City of Greene has an aerated lagoon.

For all sites sampled on the Winnebago, Shell Rock, and Cedar rivers during Project AWARE 2008, volunteers collected data using IOWATER field methods. In addition, field meters were also used to measure dissolved oxygen, pH, water temperature, specific conductivity, and turbidity. Field data were recorded both on waterproof paper field sheets and entered in a hand-held GPS with customized software to store the water quality information and record the UTM coordinates for each site monitored. This report summarizes the water quality from the Project AWARE 2008 sampling of 36 sites (Figure 1), and includes chemical and physical results (Table 1).

Where possible, water quality results from Project AWARE were compared to a network of 77 streams statewide that are monitored on a monthly basis as part of the Iowa Department of Natural Resources (DNR) Watershed Monitoring and Assessment Program. Data from this network have been collected since 2000 and provide perspective on what are typical stream concentrations statewide for the various parameters. In this report, this network will be referred to as the DNR statewide stream network. The August 2008 results from this network were also compared to Project AWARE results to determine relative concentrations for the same time period.

Table 1. Monitoring results from Project AWARE 2008.

	Unit	Method	# of samples	Min Value	Percentiles			Max Value
					25th	50th	75th	
Chloride	mg/L	IOWATER test strip	35	<33	<33	<33	<33	213
Dissolved Oxygen	mg/L	IOWATER field kit	36	4	8	8	8	12
Dissolved Oxygen	mg/L	Field meter	36	4.18	7.96	9.38	10.03	18.1
Nitrite-N	mg/L	IOWATER test strip	36	0	0	0	0.15	1
Nitrate-N	mg/L	IOWATER test strip	36	1	2	2	5	10
Phosphate	mg/L	IOWATER field kit	35	0.1	0.2	0.3	0.4	8
pH	pH units	IOWATER test strip	36	7	8	9	9	9
pH	pH units	Field meter	36	7.4	8.0	8.2	8.4	9.1
Specific Conductivity	µS/cm	Field meter	23	507	534	577	608	806
Temperature, Air	degrees F	Thermometer - Field	35	68	74	75	82	85
Temperature, Water	Degrees F	Field meter	36	50.2	63.6	71.2	75.3	82.8
Transparency	centimeters	IOWATER transparency tube	36	20	32	43	60	60
Turbidity	NTU	Field meter	35	2.43	6.28	12	17.8	31.7

mg/L = milligrams per liter (or parts per million - ppm)

µS/cm = microsiemens per centimeter

NTU = Nephelometric Turbidity Units

Precipitation and Stream Flow Conditions

Precipitation and stream flow conditions affect water quality, and in 2008, both caused Project AWARE to be postponed from its originally scheduled dates of June 14-21 to August 2-9 due to record river levels and extensive flooding along the Project AWARE route.

Iowa experienced an unusually wet period from the end of May to mid June. “It is doubtful that a larger amount of rain has been recorded in Iowa in only 15 days” (Harry J. Hillaker, State Climatologist; <http://www.iowaagriculture.gov/climatology/weatherSummaries/2008/fms200806.pdf>).

The above normal rainfall during the early half of June led to unprecedented river levels (Figure 2). USGS data (www.usgs.gov) indicates that water levels for the Winnebago River at Mason City, the Shell Rock River at Shell Rock, and the Cedar River at Cedar Falls all reached record levels. On June 8, the Winnebago River at Mason City had a stream flow of 10,400 CFS (previous highest daily mean was 9,370 CFS on March 27, 1961), and June 10, the Shell Rock River at Shell Rock had a stream flow of 46,400 CFS (previous highest daily mean was 32,100 CFS on March 28, 1961) and the Cedar River at Cedar Falls had a gage height of 100.33 feet (previous high was 94.99 feet on May 25, 2004). By June 14, river levels for all three rivers were declining from their highest recorded level for 2008, yet flow in both the Winnebago River and Shell Rock River were still 10 times greater than normal for this time of year, and the Cedar River at Cedar Falls was still 11 feet above normal stage level for that time of year. By the time Project AWARE began on August 2, water levels in all three rivers had approached more normal conditions for August. Flow for the Winnebago River varied from 94 to 130% of normal during the week of Project AWARE, the Shell Rock River ranged from 116 to 140% of normal, and the Cedar River at Cedar Falls was 100% of normal. Air temperatures were below normal for August 2-9, and rain only fell the morning of Monday August 4, shortly after participants put on the Winnebago River at Rockford.

Environmental Concerns from Flooding

When Project AWARE 2008 had to be rescheduled, environmental and safety concerns were raised. Once rescheduled, would river levels be at safe levels? What had the floods washed into the rivers? Was the water safe for primary contact? Would orphan containers (tanks, drums, cylinders, and barrels containing unknown substances that had washed into the rivers) be present along the route and pose a hazard to Project AWARE participants? Given the planning involved for the event, organizers needed to select dates for the rescheduled event and hope that water levels would be at more normal levels. As Figure 2 indicates, levels for all three rivers were slightly above normal if not near normal for the beginning of August when Project AWARE occurred.

To address questions statewide about the impact on water quality from the Floods of 2008, a subset of the streams monitored monthly as part of the DNR statewide stream network were sampled more frequently during the summer of 2008 and were also analyzed for a more comprehensive list of compounds. Figure 3 shows the sites on the Winnebago, Shell Rock, and Cedar (Cedar Falls/Waterloo) rivers along the Project AWARE route that were monitored more frequently, and Figure 4 shows the results for *E. coli* bacteria. Iowa’s *E. coli* bacteria standard for primary contact is 235 Colony Forming Units per 100 milliliters (CFU/100 ml). When Project AWARE occurred in August, *E. coli* bacteria levels were below 235 CFU/100 ml for all of the sites along the Project AWARE 2008 route except for the site immediately downstream of Mason City (Figure 4).

On July 29-30, 2008, Project AWARE staff scouted the entire stretch of the Project AWARE route prior to the actual event to identify potential hazards or other areas of concern. No major hazards or obstacles were noted. The staff was able to identify river stretches that had unusually large volumes of debris, much of which was flood related. Arrangements were then made to have a large, flat bottomed boat available to help offload canoes when full and to more efficiently remove trash from the river for those stretches.

In response to the hazard which orphan containers potentially posed, the Iowa DNR, U.S. Environmental Protection Agency, and the Federal Emergency Management Association worked to identify and remove orphan containers from along all of Iowa’s waterways affected by the flooding. By the time Project AWARE was rescheduled for August, all orphan containers had been removed from the Winnebago, Shell Rock, and Cedar rivers between Mason City and Cedar Falls. The scouting trip the end of July confirmed their removal.

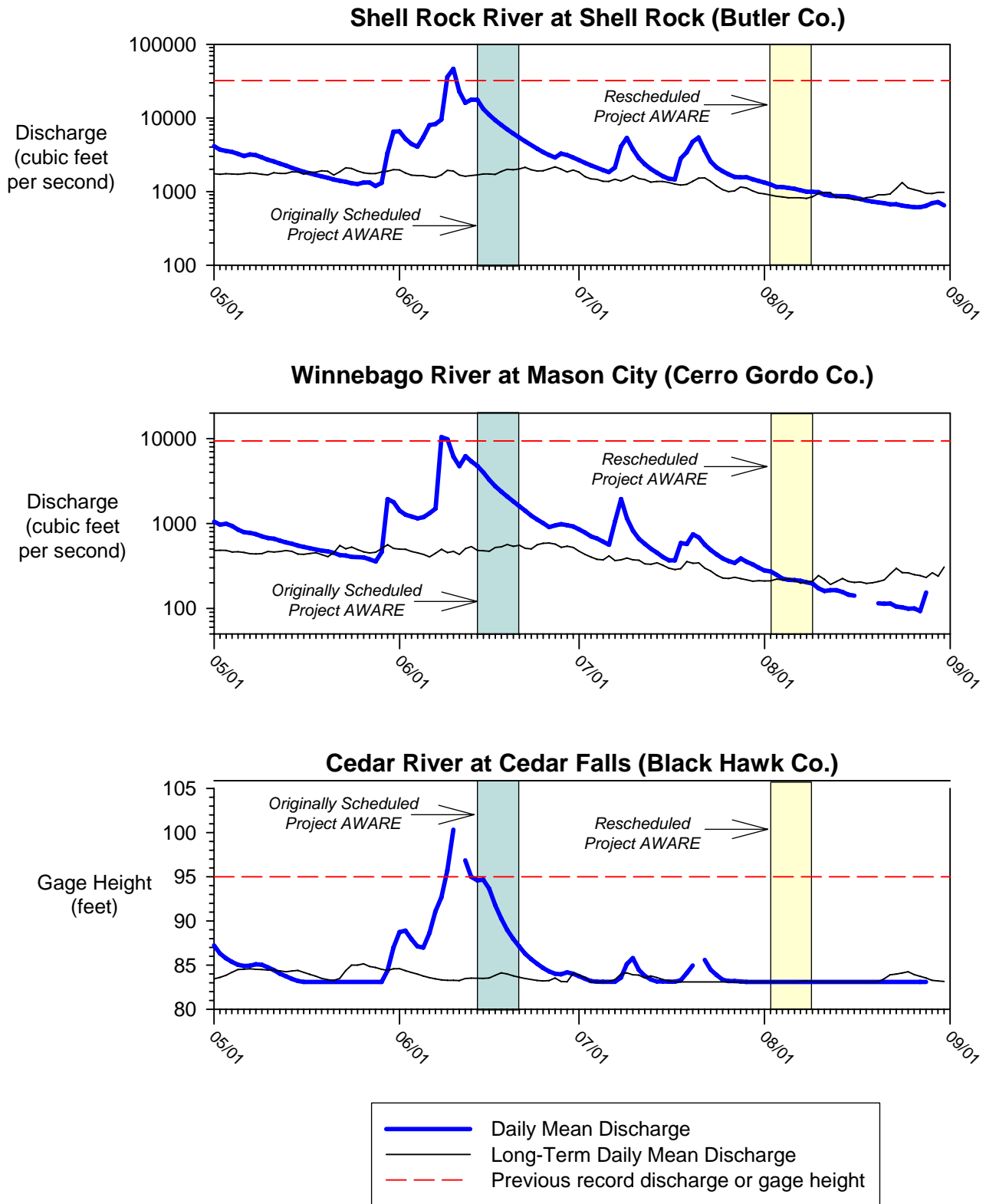


Figure 2. Discharge for the Winnebago River, Shell Rock River, and Cedar River at Cedar Falls for May 2008 through August 2008. The teal shaded area represents when Project AWARE was originally scheduled for June 14-21, 2008, and the yellow shaded area represents when Project AWARE was rescheduled for August 2-9, 2008. Data from <http://ia.water.usgs.gov>.

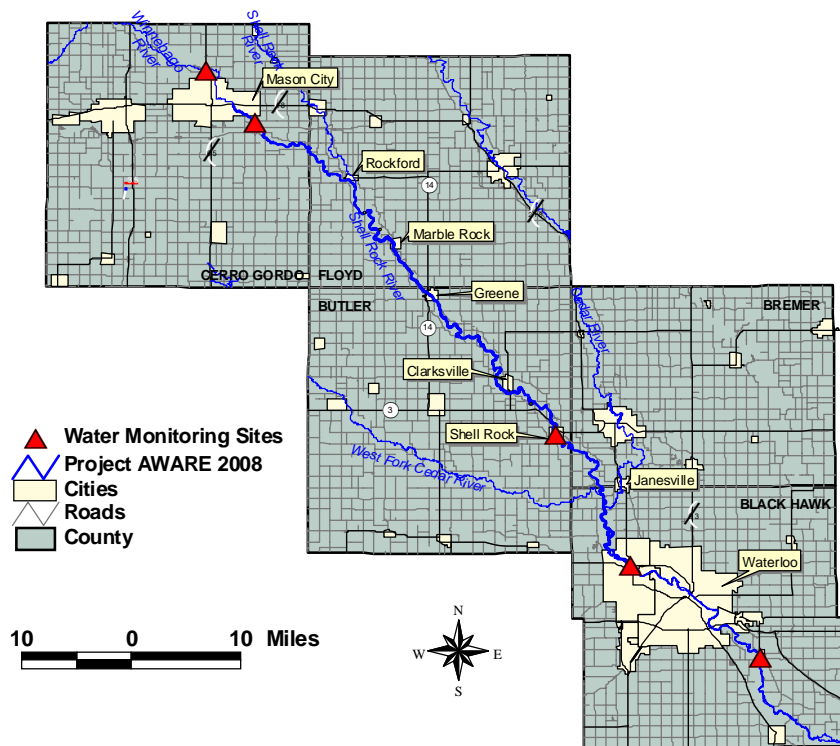


Figure 3. Iowa DNR Watershed Monitoring and Assessment Program stream sites located along and near the Project AWARE 2008 route. These sites are normally monitored on a monthly basis, however, were sampled on a weekly to bi-weekly basis in response to the Floods of 2008.

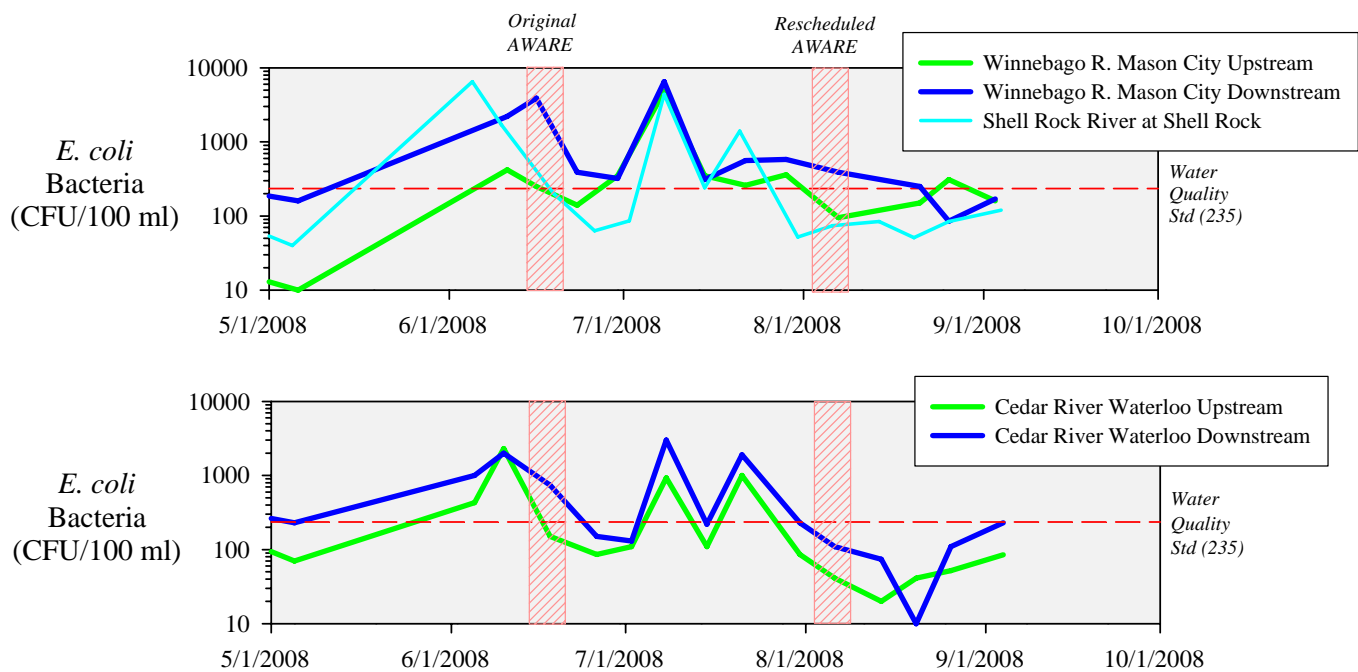


Figure 4. *E. coli* bacteria levels for the Winnebago River, Shell Rock River, and Cedar River for May through September 2008. Sites are normally monitored on a monthly basis, but sampling frequency increased during the summer of 2008 in response to flooding along these rivers. Monitoring occurred as part of the DNR statewide stream network.

Chemical and Physical Parameters

Water Temperature

Water temperature affects many of the biological, chemical, and physical processes in a stream, including the amount of oxygen gas that can dissolve in water, the rate of photosynthesis by algae and plants, as well as the metabolic rate of aquatic animals.

Water temperature was measured at 36 sites during Project AWARE 2008 and varied from 50 to 83 degrees Fahrenheit (Table 1; Figure 5). The warmest temperature occurred at a small stream entering the Shell Rock River on river left below the City of Greene. It is believed that this stream receives discharge from a wastewater treatment facility. In addition to having the warmest water temperature, results from this site had the highest dissolved oxygen (18.1 mg/L), highest nitrite-N (1 mg/L), one of the higher phosphate results (3 mg/L), the second highest chloride (154 mg/L), and the highest pH (9.1). Field notes from this site indicate the presence of stringy algae in the area where the discharge was occurring.

Figure 6 compares the results of selected parameters from Project AWARE to the DNR statewide stream network. Water temperatures for sites monitored on Project AWARE were lower than streams statewide and exhibited a slightly greater range. When looking at the distribution of August 2008 water temperatures for streams monitored statewide, sites in the northeast quarter of Iowa, including those rivers paddled as part of Project AWARE, overall had lower water temperatures relative to streams elsewhere in Iowa.

pH

pH is a measure of water's acid/base content. Changes in pH can be caused by atmospheric deposition of acid rain, the types of soils and bedrock that the water comes in contact with, wastewater discharges, and acid mine drainage. A pH of 7 is neutral; pH values greater than 7 are alkaline or basic, while a pH less than 7 is acidic.

pH levels ranged from 7 to 9 using the IOWATER test strip and ranged from 7.4 to 9.1 using the pH field meter (Table 1; Figures 7 and 8). The highest pH occurred at the small stream entering just below the City of Greene. The pH levels measured at sites sampled as part of Project AWARE are similar to those typically measured in streams statewide and were similar to those reported in August 2008 for the DNR statewide stream network (Figure 6).

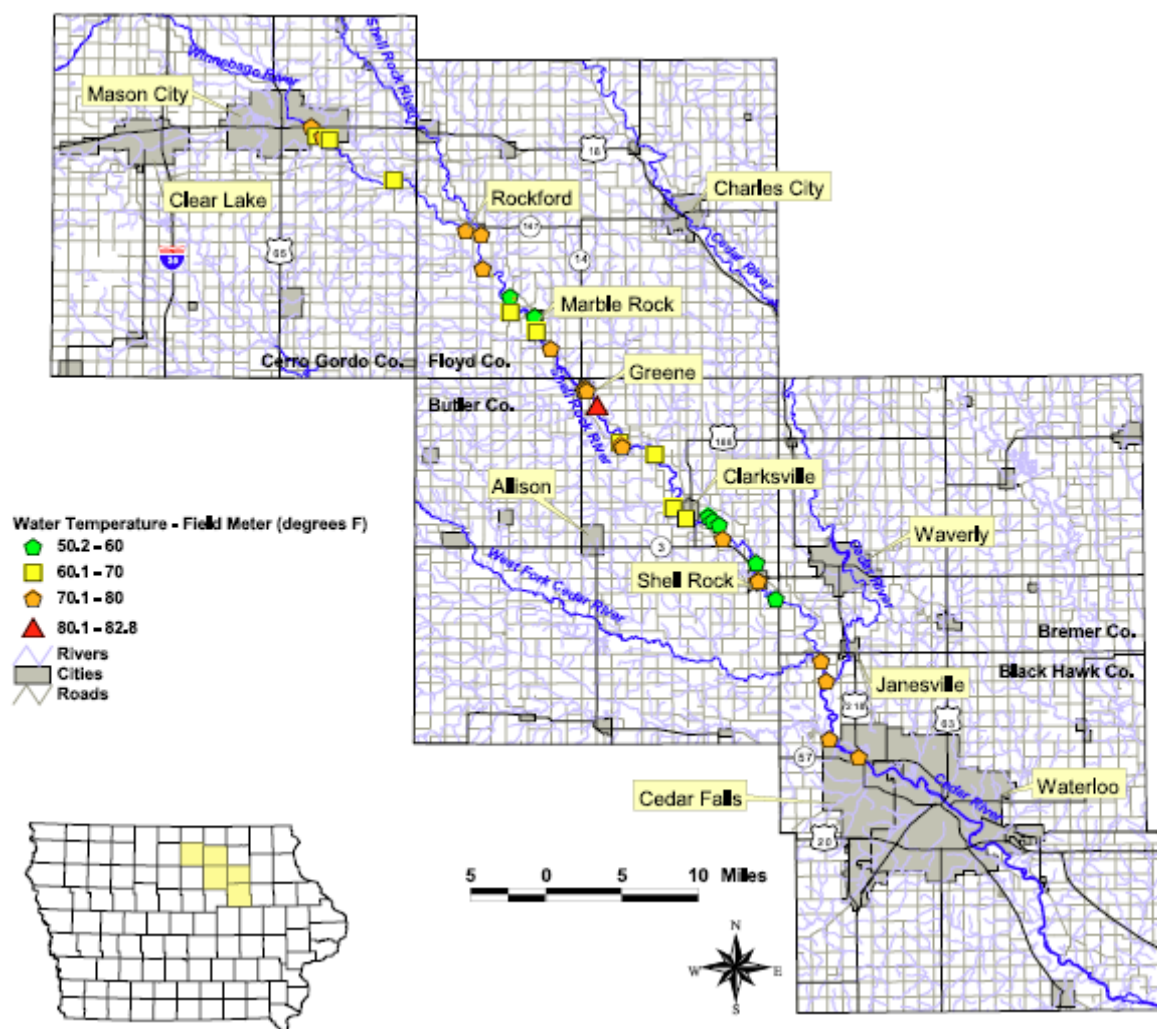


Figure 5. Water temperature (field meter) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

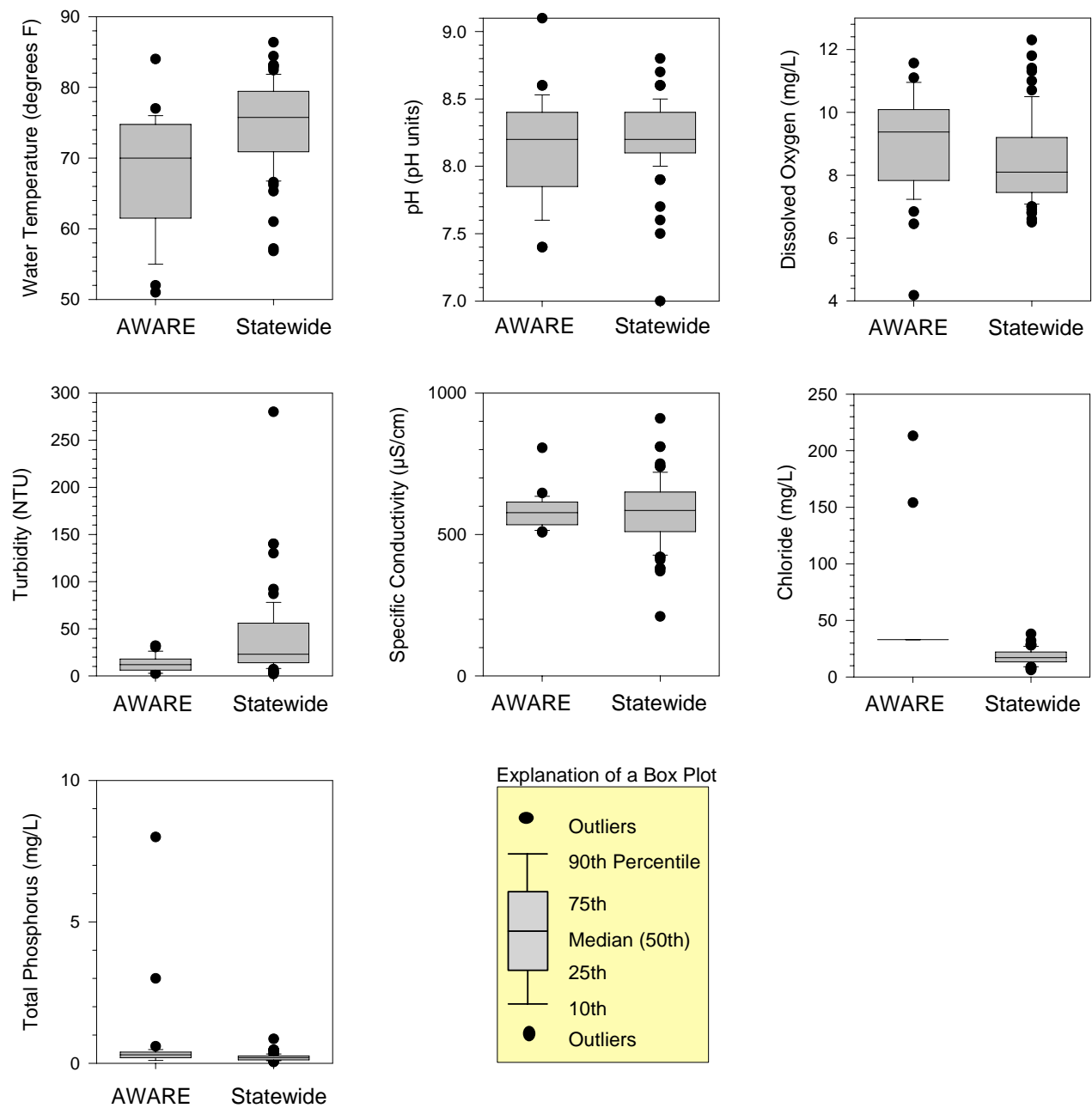


Figure 6. Box plots comparing water quality results for sites sampled during Project AWARE 2008 to the DNR statewide stream network for August.

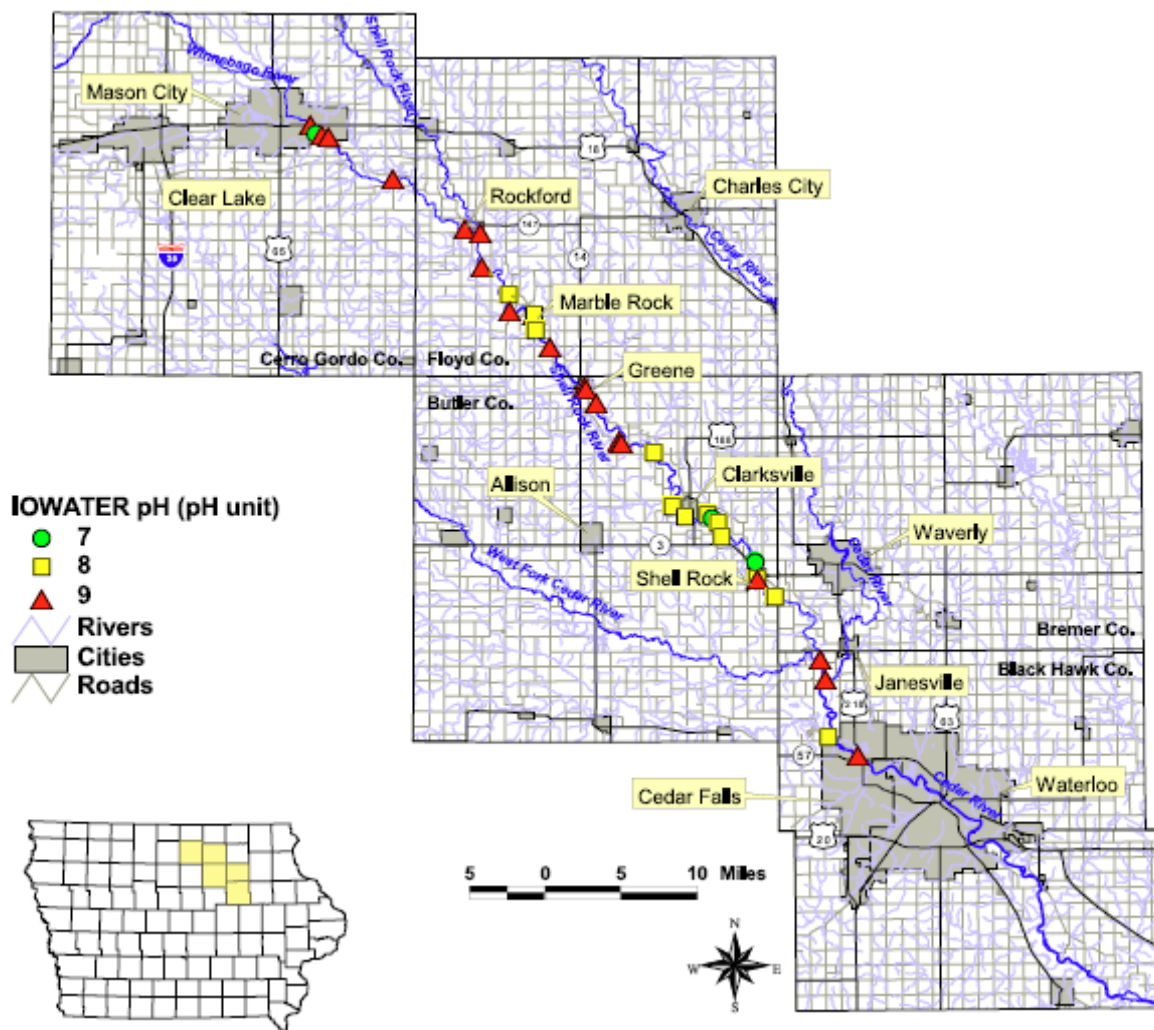


Figure 7. pH (IOWATER method) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

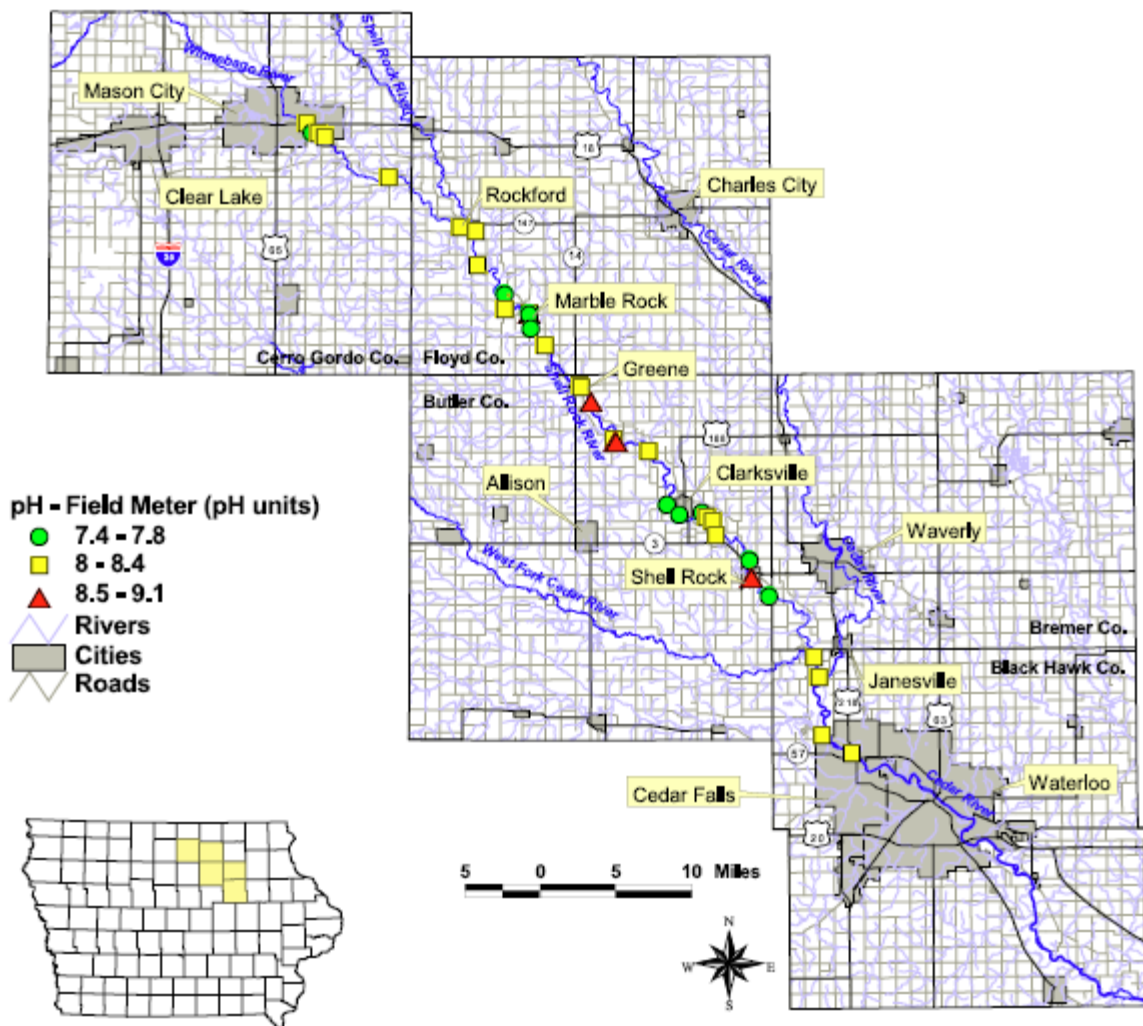


Figure 8. pH (field meter) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Transparency

Transparency is a measure of water clarity and is affected by the amount of material suspended in water. As more material is suspended in water, less light can pass through the water, making it less transparent (or more turbid). These materials include soil, algae, plankton, and microbes.

Transparency ranged from 20 to 60 centimeters (cm) for all Project AWARE sites (Table 1; Figure 9). Transparency varied from 20 to 43 cm for sites on the main stem and ranged from 26 to 60 cm for tributary sites. The three other sites had transparencies that ranged from 48 to 60 cm. Overall, transparency levels were relatively high, likely in response to the lack of any recent rains.

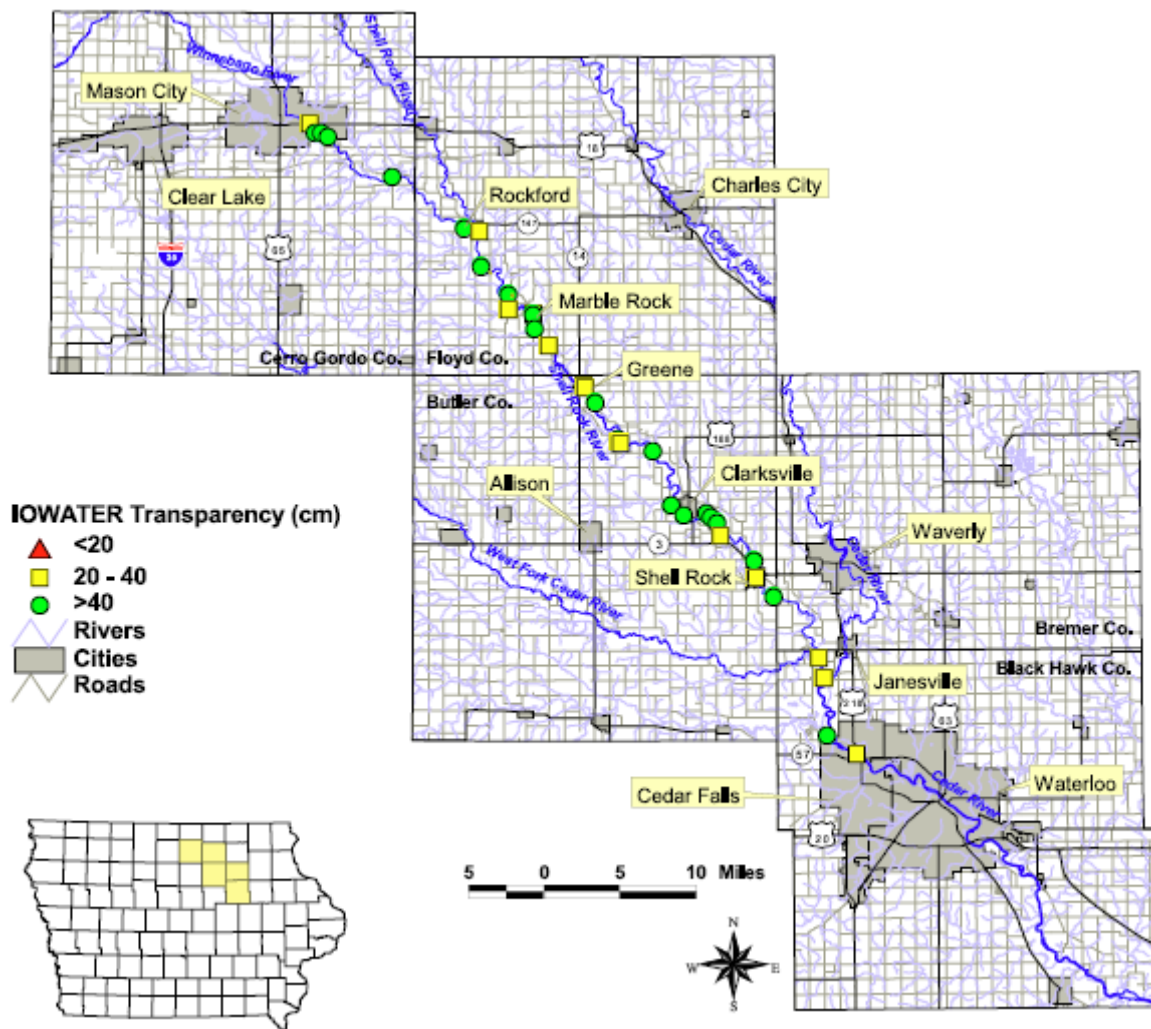


Figure 9. Water transparency (IOWATER method) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Dissolved Oxygen

Dissolved oxygen levels in a stream can be affected by a number of variables, including water temperature, season of the year, time of day, stream flow, presence of aquatic plants, dissolved or suspended solids, and human impacts. Oxygen enters a stream through diffusion from the surrounding air and as a product of photosynthesis from aquatic plants. Oxygen in a stream can be consumed through respiration by aquatic plants and animals, and by the decomposition of organic matter. Iowa has a water quality standard minimum of 5 mg/L of dissolved oxygen for warmwater streams.

For Project AWARE sites, dissolved oxygen ranged from 4 to 12 mg/L using the IOWATER method and ranged from 4.18 to 18.1 mg/L using the field meter (Table 1; Figures 10 and 11). All but one of the sites monitored had dissolved oxygen concentrations that met the water quality standard minimum of 5 mg/L for warmwater streams. The lowest dissolved oxygen (4.18 mg/L) was measured at a tributary which enters the Shell Rock River ~2 miles downstream of the City of Clarksville. It is unknown why the level was so low, as the other water quality results for this site indicated nothing unusual about this particular location. Dissolved oxygen concentrations were higher than levels measured in streams statewide in August 2008 (Figure 6).

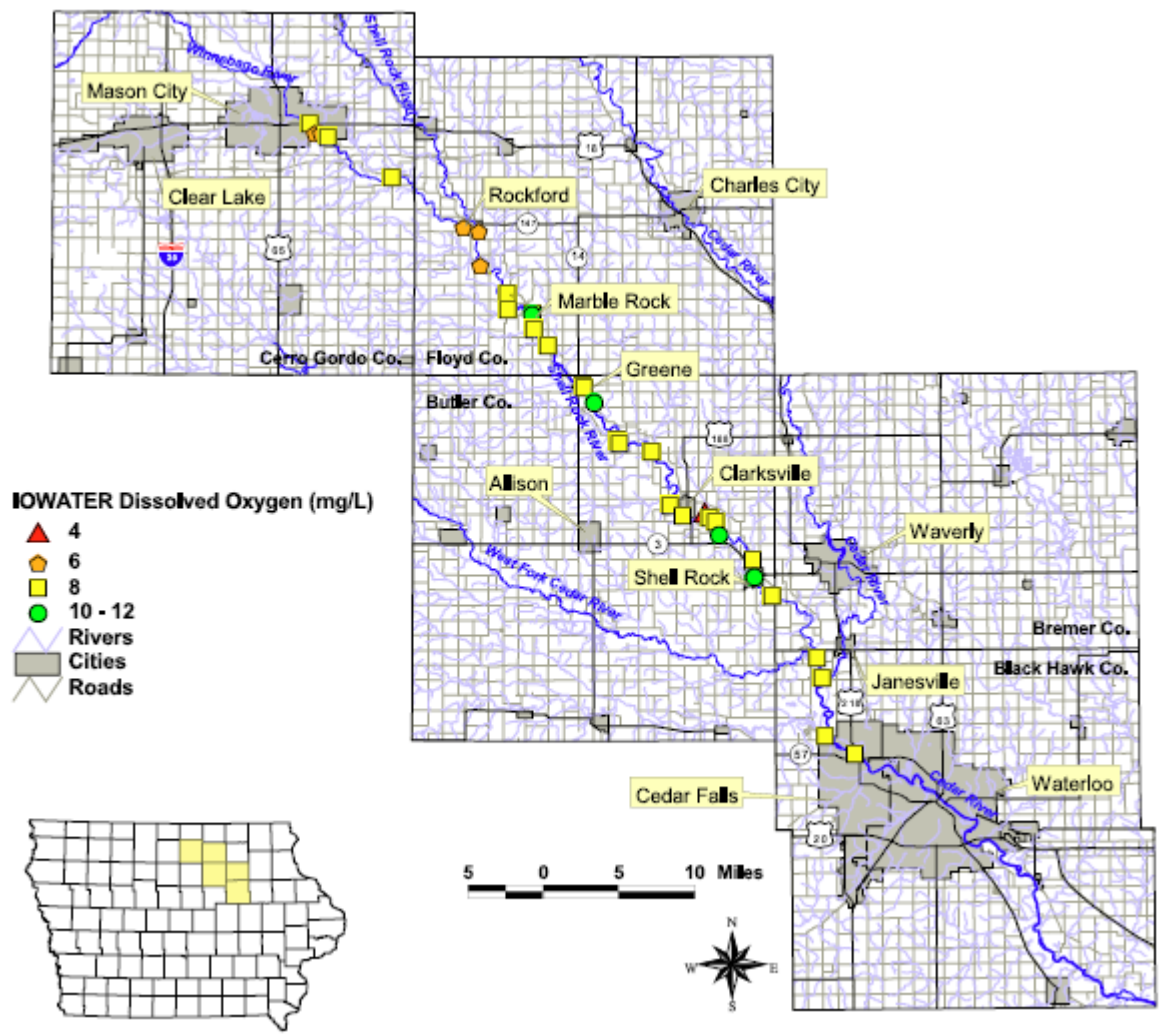


Figure 10. Dissolved oxygen (IOWATER method) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

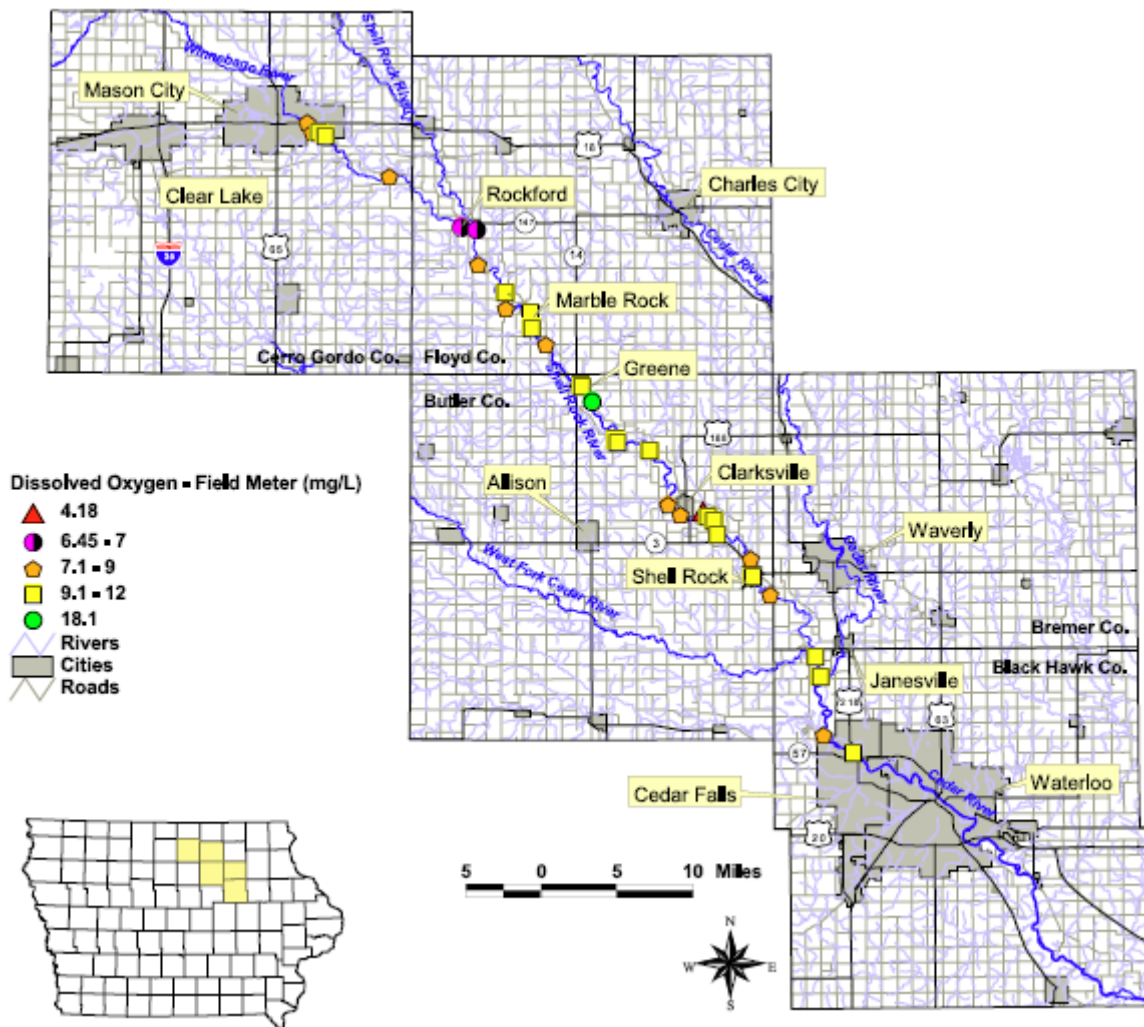


Figure 11. Dissolved oxygen (field meter) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Nitrite-N and Nitrate-N

Nitrogen is a necessary nutrient for plant growth, and includes both nitrite- and nitrate-nitrogen. Too much nitrogen in surface waters, however, can cause nutrient enrichment, increasing aquatic plant growth and changing the types of plants and animals that live in a stream. Sources of nitrogen include soils; human and animal wastes; decomposing plants; and fertilizer runoff from golf courses, lawns, and cropland. Typical nitrate+nitrite-N concentrations for Iowa streams range from 2.9 to 8.7 mg/L, with higher concentrations generally occurring in the late spring/early summer. Nitrite-N and nitrate-N are not measured separately as part of the DNR statewide stream network, rather it is measured as nitrate+nitrite-N.

Nitrite-N was measured at Project AWARE sites using the IOWATER method (Table 1; Figure 12). Concentrations ranged from 0 to 1.0 mg/L. Thirteen of the 36 sites had measurable levels of nitrite-N of 0.15 or 1.00 mg/L using the IOWATER method. Both wastewater discharge locations reported measurable amounts of nitrite-N.

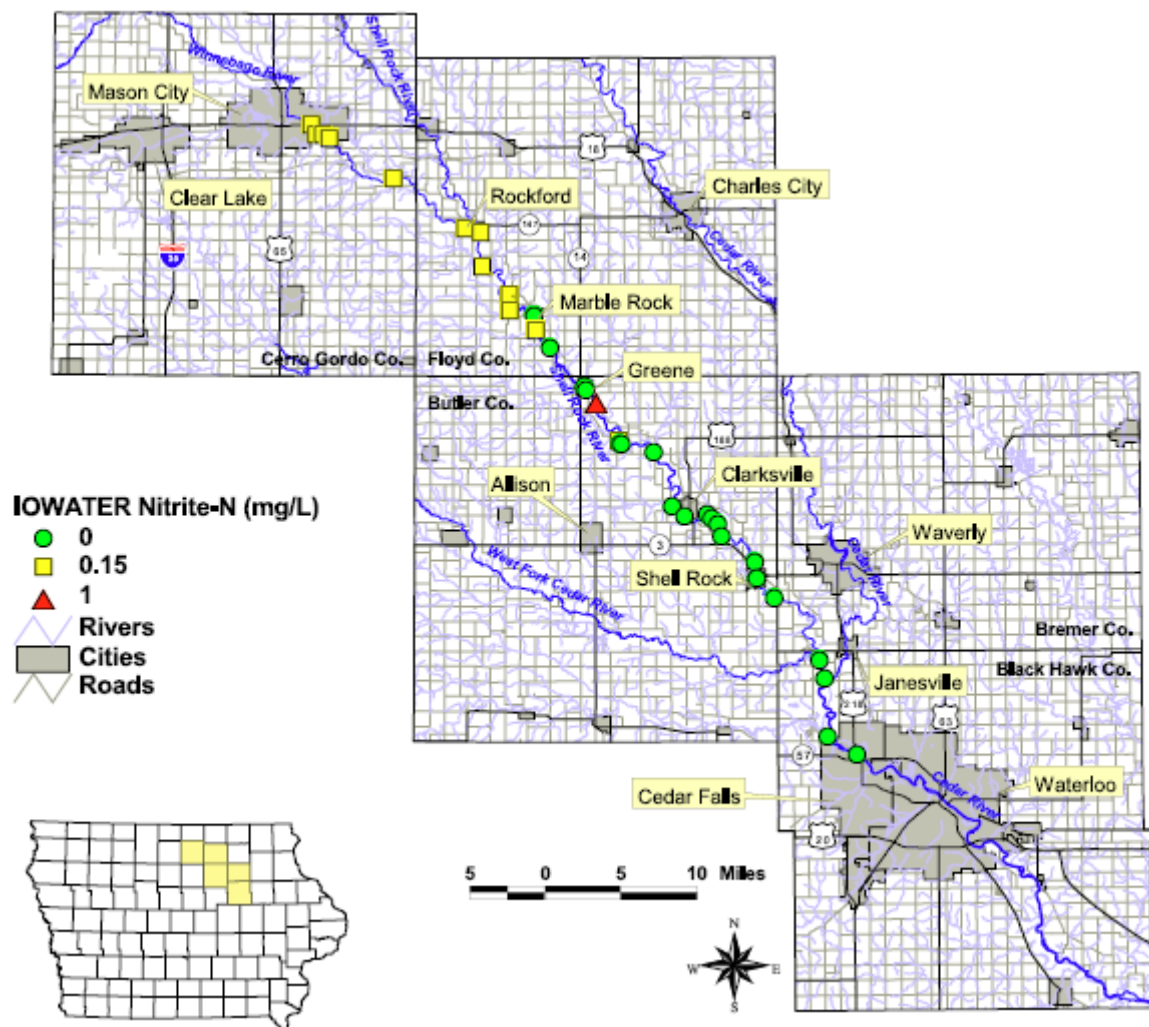


Figure 12. Nitrite-N (IOWATER method) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Nitrate-N was measured at Project AWARE sites using the IOWATER method (Table 1; Figure 13). Nitrate-N ranged from 1 to 10 mg/L (median of 2 mg/L). The lowest nitrate-N concentration was 1 mg/L and occurred at a tributary entering river left into the Shell Rock River just upstream of the boat ramp at Heery Woods State Park. The highest concentration was 10 mg/L and occurred at the outfall associated with the City of Mason City's wastewater facility. This site also had the highest chloride (213 mg/L) and orthophosphorus (8 mg/L). Specific conductivity was not measured at this site.

Nitrate-N concentrations were 2 mg/L for all sites on the main stem, 1 to 5 mg/L for tributary sites, and 5 to 10 mg/L for all other sites. Based on monthly data collected from DNR's statewide stream network, the median nitrate+nitrite-N concentration for samples collected during August is 3.6 mg/L.

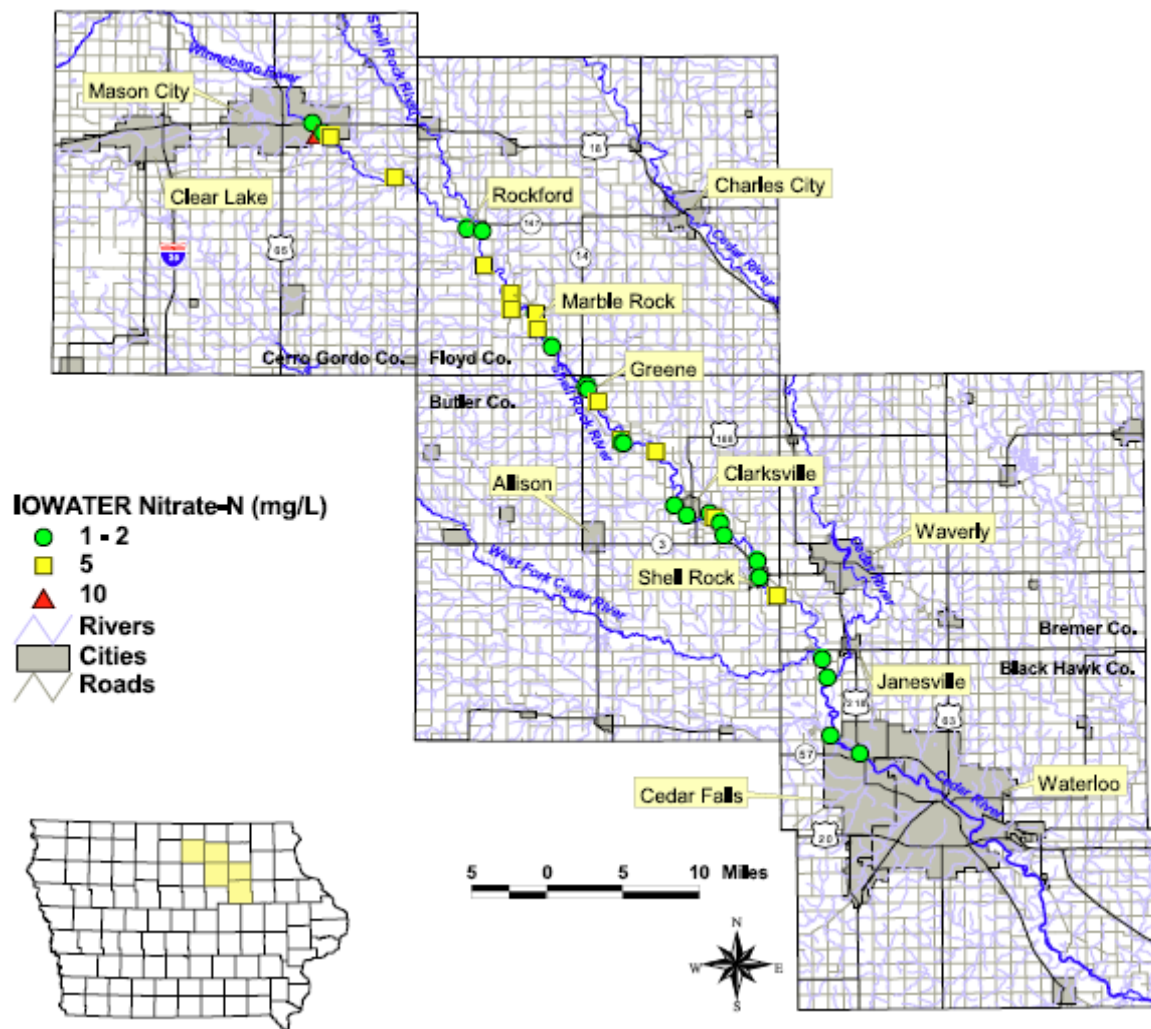


Figure 13. Nitrate-N (IOWATER method) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Phosphorus

Phosphorus is a necessary nutrient for plant growth. Too much phosphorus in surface waters, however, can cause nutrient enrichment, increasing aquatic plant growth, and changing the types of plants and animals that live in a stream. Sources of phosphorus include certain soils and bedrock; human and animal wastes; detergents; decomposing plants; and runoff from fertilized lawns and cropland. Orthophosphorus is the form of phosphorus most available for plants to use. Typical concentrations of total phosphorus in streams statewide vary from 0.11 to 0.34 mg/L, with a median of 0.20 mg/L.

For Project AWARE, phosphate was measured using the IOWATER method. IOWATER phosphate results ranged from 0.1 to 8 mg/L, with a median of 0.3 mg/L (Table 1; Figure 14). The two highest phosphate results (3 and 8 mg/L) were associated with sites receiving inputs from wastewater treatment facilities. Excluding those results, phosphate results from Project AWARE were similar to levels in streams statewide during August 2008 (Figure 6).

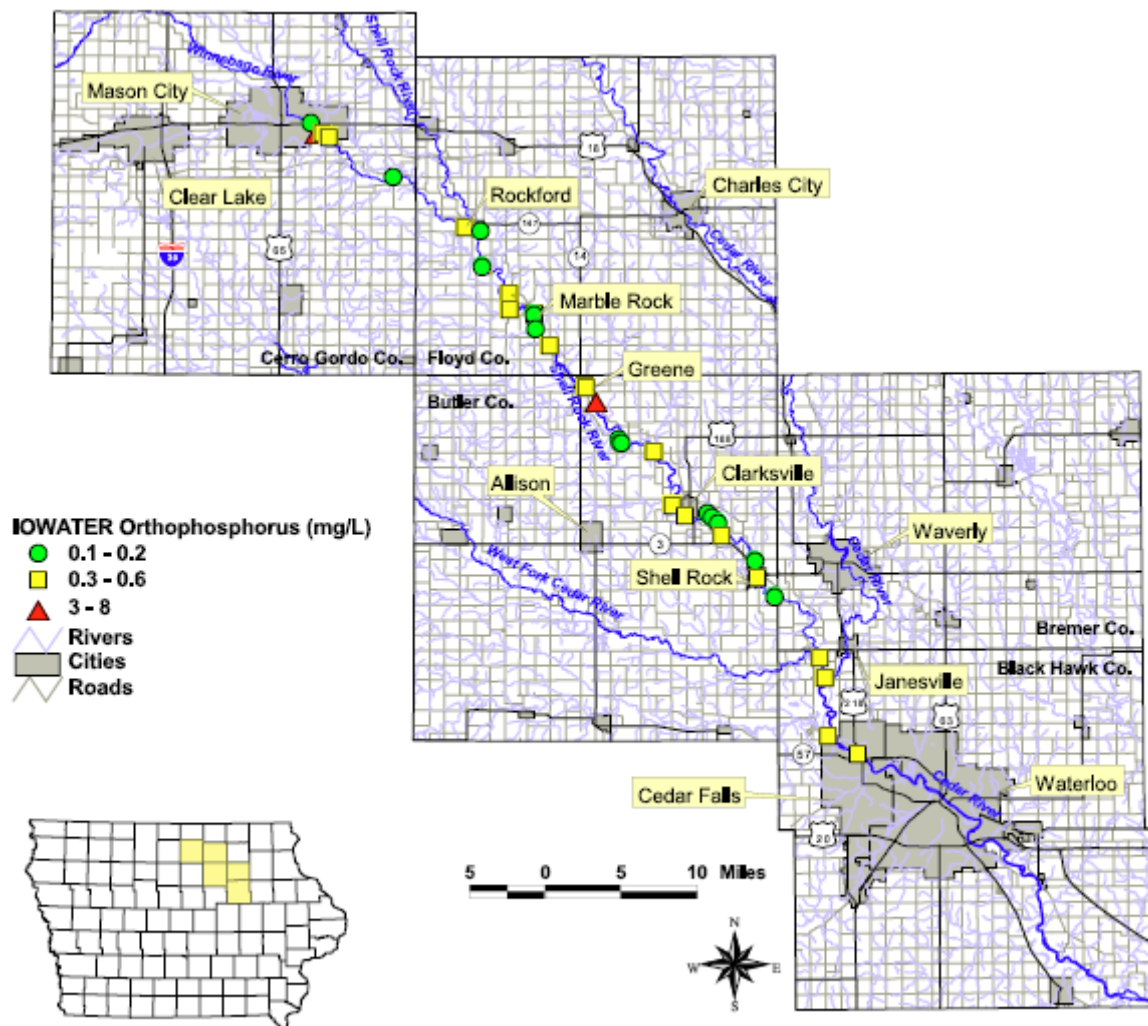


Figure 14. Phosphate (IOWATER method) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Chloride

Chloride is a component of salt and is a measure of human or animal waste inputs to a stream. Potential sources of chloride to a stream include direct input from livestock, septic system inputs, and/or discharge from municipal wastewater facilities. During winter months, elevated chloride levels in streams may occur as a result of road salt runoff to nearby streams. Typical concentrations of chloride in Iowa streams range from 17 to 30 mg/L, with a median of 23 mg/L, with higher concentrations during winter months.

For Project AWARE sites, IOWATER chloride concentrations ranged from <33 to 213 mg/L, with a median of <33 mg/L (Table 1; Figure 15). The highest chloride concentrations (154 and 213 mg/L) occurred at the two sites associated with wastewater treatment facilities. Excluding these two sites, chloride results overall were very low and similar to levels in streams statewide for August 2008 (Figure 6).

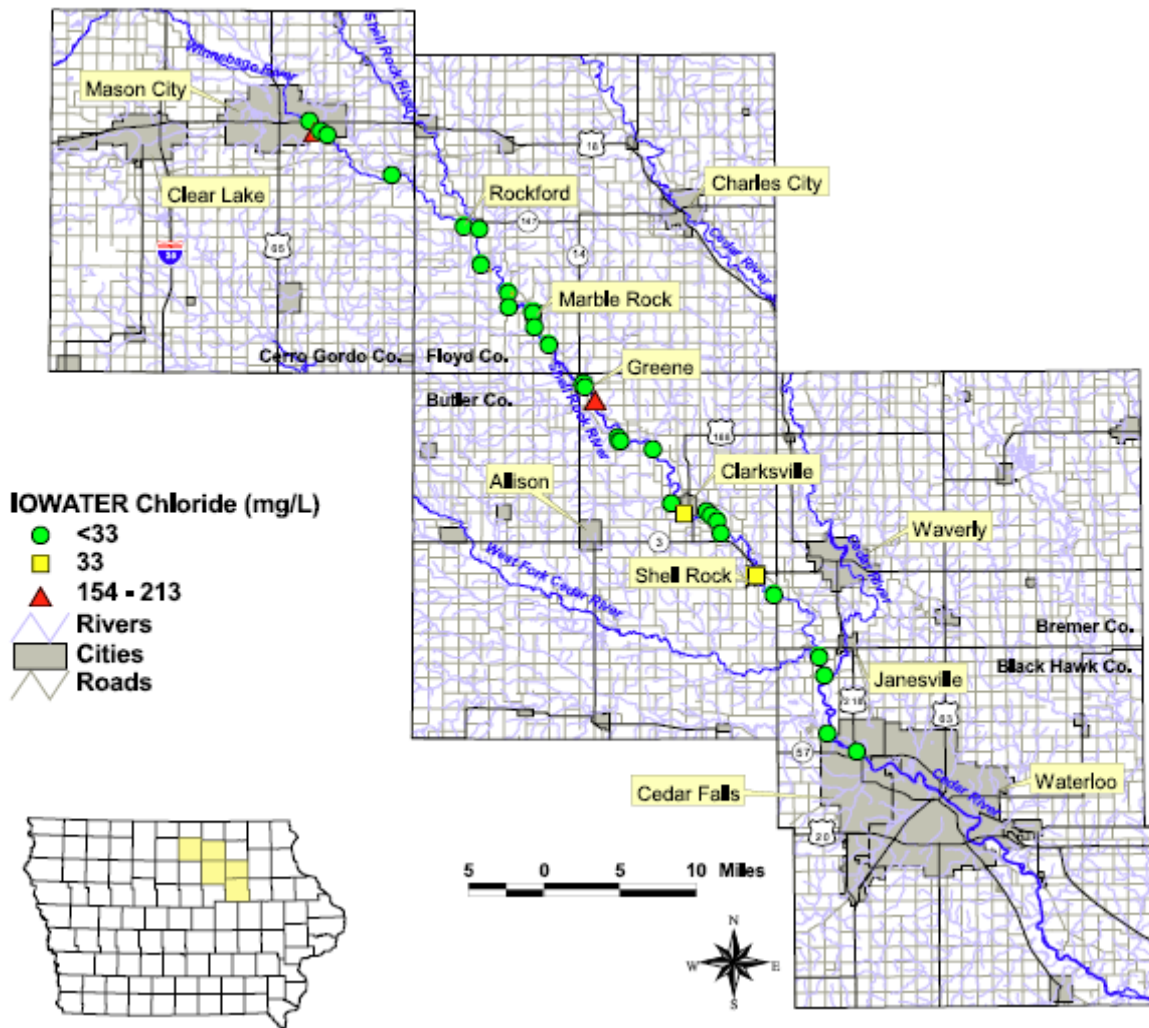


Figure 15. Chloride (IOWATER method) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Specific Conductivity

Specific conductivity is a measure of how well water can conduct an electrical current. Conductivity increases with the increasing amount and mobility of ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Therefore, specific conductance is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution. Typical specific conductivity levels for streams statewide vary from 510 to 720 $\mu\text{S}/\text{cm}$, with a median of 620. Higher levels tend to occur in northwest Iowa relative to the rest of the state.

Specific conductivity was measured using a field meter. Specific conductivity levels at these sites ranged from 507 to 806 $\mu\text{S}/\text{cm}$ with a median of 577 (Table 1; Figure 16). Except for the highest conductivity which was associated with a wastewater discharge, the other results all fell within a very narrow range, from 507 to 646 $\mu\text{S}/\text{cm}$. The conductivity meter was not available for use during the first two days of monitoring, so results were only reported for 23 of the 36 sites. Conductivity levels were similar between main channel and tributary sites.

Specific conductivity levels for sites sampled as part of Project AWARE were similar to levels in streams statewide for August 2008 (Figure 6), although the range in conductivity was less for the Project AWARE sites. The median

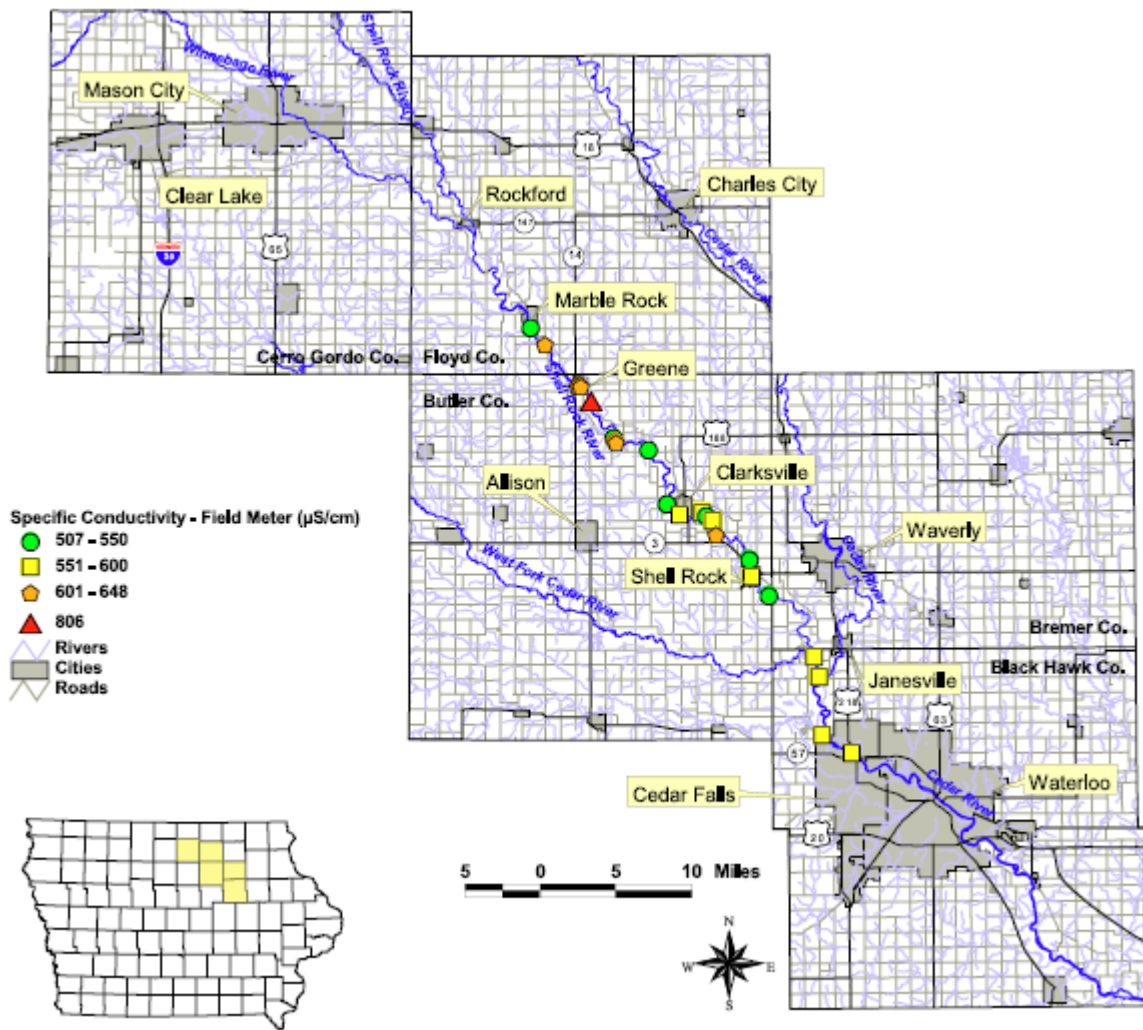


Figure 16. Specific conductivity (field meter) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

specific conductivity was $577 \mu\text{S}/\text{cm}$ for Project AWARE sites and $585 \mu\text{S}/\text{cm}$ for streams statewide during August 2008.

Turbidity

Turbidity refers to how turbid or dirty the water is. The greater the amount of total suspended solids or algae in the water, the murkier it appears and the higher the measured turbidity. A major source of turbidity in rivers is typically from overland runoff flows, stream bank erosion, re-suspension of bottom sediments, and organic detritus from stream and/or wastewater discharges. Dredging operations, channelization, increased flow rates, floods, or even too many bottom-feeding fish (such as carp) may stir up bottom sediments and increase the cloudiness of the water. Typical turbidity levels in Iowa streams statewide range from 6 to 43 Nephelometric Turbidity Units (NTU) with a median of 17 NTU.

Turbidity was measured using a field meter. Turbidity ranged from 2.43 to 31.7 NTU, with a median of 12 (Table 1; Figure 17). Sites with high turbidity levels had low transparency readings, and vice versa. Turbidity levels tended to be highest on the main channel sites followed by the tributary sites and the other sites.

Figure 6 compares the turbidity results from Project AWARE to results from the DNR statewide stream network for August 2008. Project AWARE turbidity levels were lower than levels statewide, and also had a smaller range.

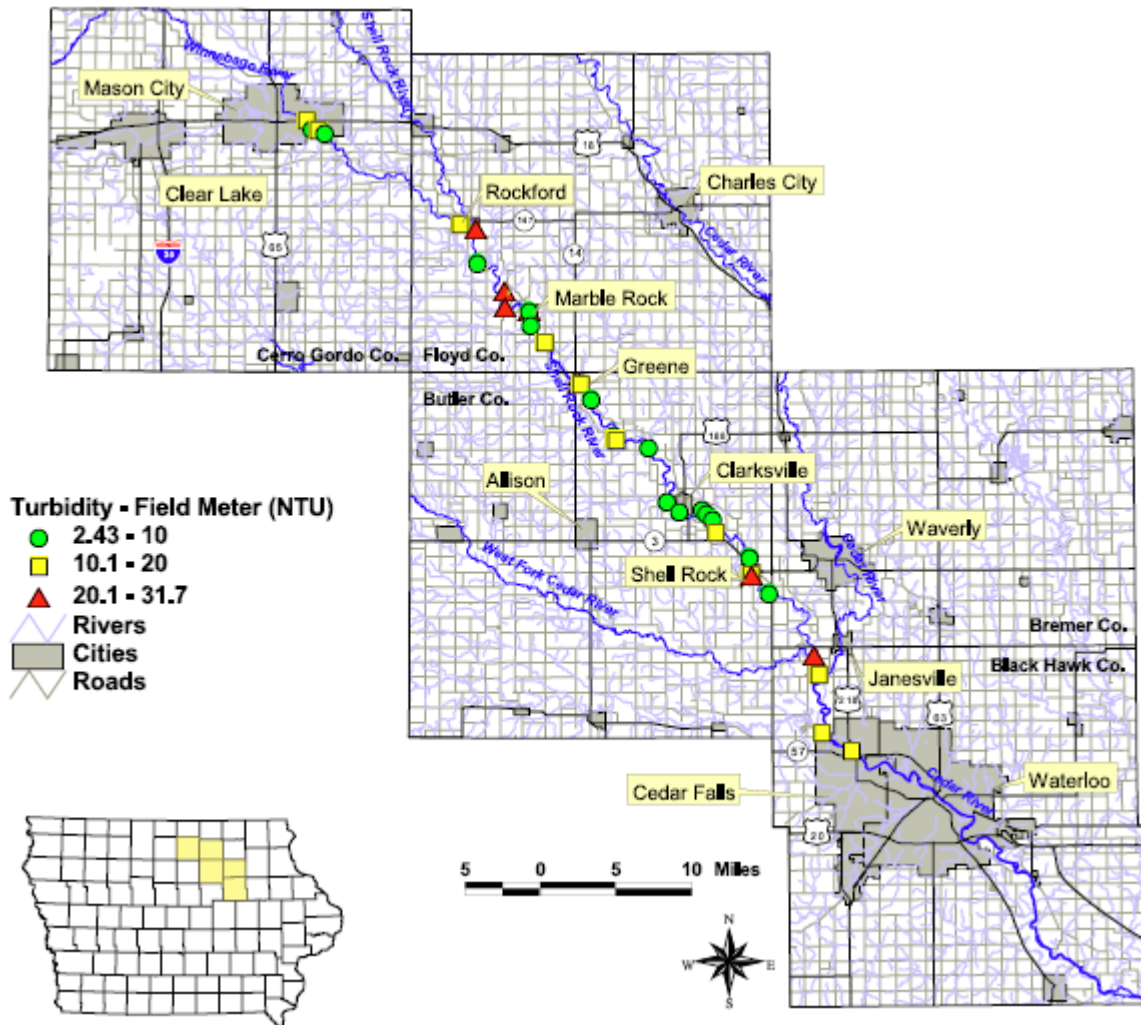


Figure 17. Turbidity (field meter) for sites sampled as part of Project AWARE 2008 on the Winnebago, Shell Rock, and Cedar rivers.

Median turbidity levels for streams statewide in August 2008 was 23 NTU compared to 12 NTU for Project AWARE sites.

Water Quality Above and Below Dams

This year's Project AWARE route encountered five low-head dams (City of Marble Rock, City of Greene, Camp Comfort, Heery Woods State Park, and Shell Rock). Monitoring sites were established upstream and downstream of four of the five dams (Heery Woods was not included) to determine if the dams caused any difference(s) in water quality. Keep in mind that this monitoring represents just one set of samples and is not indicative of water quality at all times throughout the year. Both the above and below dam sites at each location were sampled the same day. Water quality results from these sites showed little to no difference between the upstream and downstream dam sites, including results for transparency and turbidity. Only for dissolved oxygen were concentrations slightly higher at the downstream site relative to the upstream site.

Summary

In addition to 46.4 tons of trash removed during Project AWARE 2008, a total of 36 sites were monitored for a variety of field and lab parameters.

Below are some observations from the data.

- Project AWARE occurred from August 2-9, 2008, during slightly above to normal stream flow conditions. Flow for the Winnebago River varied from 94 to 130% of normal during the week of Project AWARE, the Shell Rock River ranged from 116 to 140% of normal, and the Cedar River at Cedar Falls was 100% of normal. Air temperatures were below normal for this time of year.
- As part of the Iowa Department of Natural Resources (DNR) Watershed Monitoring and Assessment Program, a network of 77 streams across Iowa is monitored on a monthly basis. In response to the flooding, these sites were sampled more frequently. Results for sites along the Project AWARE route indicated that when Project AWARE began, *E. coli* bacteria levels for all sites along the route but one were below the water quality standard for primary contact of 235 CFU/100 ml. The exception was the site on the Winnebago River downstream of Mason City which had an *E. coli* level of 390 CFU/100 ml.
- Water temperature for sites sampled ranged from 50 to 83 degrees Fahrenheit. These temperatures were lower than levels measured in streams statewide during August and also displayed a slightly greater range in values.
- pH ranged from 7.4 to 9.1. Overall, pH was similar to streams statewide.
- Transparency ranged from 20 to 60 centimeters. Transparency tended to be lower for main channel relative to tributary sites.
- Dissolved oxygen concentrations varied from 4.18 to 18.1 mg/L. Dissolved oxygen concentrations for all but one site met or exceeded the water quality standard for warmwater streams of 5 mg/L. Results were similar to levels measured statewide during August 2008.
- Nitrite-N concentrations ranged from 0 to 1.0 mg/L with 13 of the 36 sites having detectable levels of nitrite-N.
- Nitrate-N concentrations ranged from 1 to 10 mg/L with the highest concentration occurring at a site associated with a wastewater treatment facility. Overall, concentrations were similar to levels reported in streams statewide for August.
- Phosphate ranged from 0.1 to 8 mg/L, with a median concentration of 0.3 mg/L. The two highest concentrations were associated with wastewater treatment facilities. If those results were excluded, phosphate levels were similar to those for streams across Iowa for August.
- Chloride ranged from <33 to 213 mg/L, with a median of <33 mg/L. The two highest readings, 213 and 154 mg/L, were associated with point source inputs. Overall, levels were similar to statewide values.
- Specific conductivity ranged from 507 to 806 $\mu\text{S}/\text{cm}$, with a median of 577. The highest result was associated with a point source; otherwise, levels were similar to statewide results.
- Turbidity ranged from 2.43 to 31.7 NTU, with a median of 12. Higher turbidity occurred on the main channel sites relative to the tributaries. Results from Project AWARE were lower than levels measured statewide for August 2008.

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